TECHNICAL PROGRESS REPORT NO. 138 JULY 1963

Tomato (*Lycopersicon esculentum*) Herbicide Screening Trials in Hawaii

R. R. ROMANOWSKI, JR.
J. S. TANAKA
D. L. PLUCKNETT
and
D. D. F. WILLIAMS

HAWAII AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF HAWAII

ACKNOWLEDGMENT

Thanks are extended to Mr. Herbert Waki and Mr. Noboru Kanda, Superintendents of the Waimanalo and Poamoho Experimental Farms, respectively, for their help in conducting the experiments. The able assistance of Mr. Henry Oshiro was appreciated throughout the course of the experiments and the helpful suggestions by Mr. Yukio Nakagawa, Assistant Specialist in Horticulture, Hawaii Cooperative Extension Service, were greatly appreciated.

The herbicides used in the experiments were supplied through the courtesy of Amchem Products, Inc.; Thompson Hayward Chemical Co.; Pittsburgh Plate Glass Co.; Diamond Alkali Co.; California Chemical Co.; Eli Lilly and Co.; E. I. DuPont de Nemours & Co.; Geigy Agricultural Chemicals; Monsanto Chemical Co.; Niagara Chemical Division of FMC Corporation; Stauffer Chemical Co.; and Standard Oil Co. in Honolulu.

TECHNICAL PROGRESS REPORT NO. 138 JULY 1963

HAWAII AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF HAWAII
Honolulu, Hawaii

Tomato (*Lycopersicon esculentum*) Herbicide Screening Trials in Hawaii

R. R. Romanowski, Jr.,[1] J. S. Tanaka,[2]
D. L. Plucknett,[3] and D. D. F. Williams[4]

INTRODUCTION

The herbicide trials reported herein were initiated to test chemicals for their weed control in transplanted tomatoes grown in the Hawaiian Islands. Major emphasis was placed on chemicals granted label clearance by the U.S. Department of Agriculture as well as those which appeared promising in research trials conducted by testing agencies on the continental United States.

MATERIALS AND METHODS

Seven herbicide trials were conducted at the following locations:

Experiments 1 and 2	Poamoho Experimental Farm, Oahu
Experiments 3 and 4	Waimanalo Experimental Farm, Oahu
Experiment 5	Kauai Branch Station, Kauai
Experiment 6	Sakugawa Farm, Omaopio, Maui
Experiment 7	Nakamura Farm, Kula,Maui

[1] Dr. R. R. Romanowski is Assistant Horticulturist at the Hawaii Agricultural Experiment Station.

[2] J. S. Tanaka is Junior Horticulturist, Hawaii Agricultural Experiment Station.

[3] Dr. D. L. Plucknett is Assistant Agronomist and Plant Superintendent, Kauai Branch Station, Hawaii Agricultural Experiment Station.

[4] Dr. D. D. F. Williams is Assistant Horticulturist and Plant Superintendent, Maui Branch Station, Hawaii Agricultural Experiment Station.

Treatment Application

Herbicides were applied as sprays or granular formulations. The sprayer consisted of back-mounted fiberglass tanks which were pressured with nitrogen gas. Unless specified, solutions were sprayed at 30 p.s.i. (pounds per square inch of pressure) and 40 gal/acre (gallons per acre) of solution. The liquid formulations were applied as directed sprays to avoid contact with tomato plants or over-the-plant sprays. Further reference to the two methods will be "directed" and "over plants." All granular formulations were broadcast over the entire plot area with a hand cyclone seeder. Solan, Diquat-2, and 55 AR oil were applied postemergence to the weeds and all other chemicals were used preemergence to weed growth. Rates of chemicals are reported in pounds of active ingredient per acre.

Supplemental Irrigation

Furrow irrigation was used for experiments 1, 2, 3, and 4. Tomatoes were transplanted on furrow slopes approximately 2 to 4 inches from the bottom. Hereafter, the term "furrow" shall be used to designate the entire furrow area and "shoulder" to describe the level area between furrows. Experiments 5, 6, and 7 received no supplemental irrigation.

Cultivation

An attempt was made to maintain the cultivated checks in a weed-free condition, but this was not always possible because of weather conditions and rapid weed growth. Uncultivated checks had weeds removed after final weed ratings were taken, generally at 4 or 6 weeks after transplanting.

Methods of Evaluating Experimental Results

In addition to objective methods of measurement the following subjective weed control and crop tolerance rating systems were recorded:

Weed Control Ratings	*Crop Tolerance Ratings*
1 no control	1 no injury
2 slight control	2 slight injury
3 fair control	3 moderate injury
4 good control—commercially acceptable	4 severe injury
5 complete control	5 dead

The procedure for the subjective measurements was to study all of the checks in an experiment before the ratings were made. Subsequently, all plots were rated without knowledge of the treatments applied. Because of variable weed stands and varied tomato plant growth the treatment means presented in this report often deviate from a rating of "1" for the check plots.

List of Chemicals Used in the Experiments

Trade Name[1,2]	*Temporary Designation or Common Name*	*Chemical Name*
Amiben	amiben	3-amino-2,5-dichlorobenzoic acid
Casoron	dichlobenil	2,6-dichlorobenzonitrile
Chloro-I.P.C. "R"	C.I.P.C.	Isopropyl *N*-(3-chlorophenyl) carbamate
Dacthal W-75 "R"	DCPA	Dimethyl ester of tetrachloro-terephthalic acid
Diquat-2	diquat	1,1' ethylene-2,2'-dipyridylium dibromide
Dymid "R"	diphenamid	N,N-dimethyl-2,2-diphenylacetamide
Kloben "R"	neburon	1-n-butyl-3(3,4-dichlorophenyl) -1-methylurea
	prometryne	2,4-bis-(isopropylamino)-6-methylmercapto-s-triazine
Randox "R"	CDAA	2-chloro-N, N-diallylacetamide
Solan "R"		N-(3-chloro-4-methylphenyl)-2-methylpentanamide
Tillam "R"		Propyl ethyl-n-butylthiolcarbamate
Treflan	trifluralin	2,6-dinitro-N, N-di-n-propyl 2,2,2-trifluoro-p-toluidine
Vegadex "R"	CDEC	2-chloroallyl diethyldithiocarbamate
55 AR oil "R"		Aromatic oil (Standard Oil Co.)

[1] "R" denotes clearance for use with tomatoes. References: U.S. Department of Agriculture Summary of Registered Agricultural Pesticide Chemical Uses and reports from the respective chemical suppliers.

[2] Active ingredients of chemical formulations: Emulsifiable concentrates (pounds per gallon) Amiben and Diquat 2 lb.; Chloro-I.P.C., Randox, Solan, Treflan, and Vegadex 4 lb.; Tillam 6 lb. Wettable powders—Casoron, Dymid, and Kloben 50%; Dacthal 75%. Granulars—Chloro-I.P.C., Randox, and Vegadex 20%; Amiben 10%.

Scientific Names of the Weed Species Discussed in this Report

COMMON NAME (Hawaiian Islands)	*SCIENTIFIC NAME*
Grasses	
crabgrass	*Digitaria* spp.
lovegrass	*Eragrostis pectinacea*
jungle ricegrass	*Echinochloa colonum*
sandbur	*Cenchrus echinatus*
wiregrass	*Eleusine indica*
Broadleaves	
amaranth, spiny	*Amaranthus spinosus*
amaranth (spineless species)	*Amaranth* spp.
apple of Peru	*Nicandra physalodes*
cheeseweed, pink	*Malva parviflora*
pualele, red; flora's paint brush	*Emilia sonchifolia*
pualele, orange	*Emilia coccinea*
joee	*Stachytarpheta cayannensis*
lambsquarters	*Chenopodium album*
popolo	*Solanum nodiflorum*
pigweed (purslane)	*Portulaca oleracea*
rattle pod, smooth	*Crotolaria mucronata*
richardia	*Richardia scabra*
sow thistle	*Sonchus oleraceus*
spanish needle	*Bidens pilosa*
spurge, garden	*Euphorbia hirta*
spurge, graceful	*Euphorbia glomerifera*
stagger weed	*Stachys arvensis*
swinecress	*Coronopus didymus*
tarweed	*Cuphea carthagenensis*

RESULTS

The following results were summarized from the experiments contained in this report:[1]

CHEMICAL AND EXPERIMENT NO.	*CROP TOLERANCE*	*WEED CONTROL*
Amiben (2, 4)	None to moderate injury. Granular formulation more injurious than a directed spray.	Excellent at Waimanalo for all weeds; poor on grasses and fair on broadleaves at Poamoho.
Casoron (2, 4)	None to slight injury at two locations as a directed spray.	Poor to fair on grasses and fair to good (commercially acceptable) on broadleaves.
Chloro-I.P.C. (1, 4)	*Severe* injury in both experiments as granular formulation.	Excellent at Poamoho; poor on grasses at Waimanalo and good on broadleaves in furrow.
Dacthal (2, 3, 4, 5)	Moderate injury at only one location as a directed spray; moderate to *severe* injury when sprayed over the tomato plants.	Fair to good on grasses, but tends to leave a few wiregrass; good to excellent in residual control of certain broadleaves.
Diquat (2)	Moderate to *severe* injury as a directed spray.	Fair on grasses and fair plus on broadleaves.
Dymid (2)	No injury.	Fair on grasses and poor on broadleaves.
Neburon (1, 2, 4)	None to moderate injury, slows fruiting.	Fair to good on grasses and good on broadleaves.
Prometryne (2, 4)	Moderate injury at one location and *severe* at a second as a directed spray.	Commercially acceptable control of grasses and broadleaves.
Randox (1, 2, 3, 4, 5)	*Severe* injury when sprayed over the tomato plants and none to moderate injury when applied as a directed spray. Granular formulations similar to directed sprays.	Excellent at Waimanalo for all weeds; fair to good on grasses and poor to fair on broadleaves at the other test locations.

[1] All data are reported in the Appendix.

(Continued)

(Continued from page 7)

CHEMICAL AND EXPERIMENT NO.	*CROP TOLERANCE*	*WEED CONTROL*
Solan (1, 2, 3, 4, 5, 6)	Moderate to *severe* injury when sprayed over the tomato plants and none to slight injury as a directed spray.	Poor to fair on grasses and good to excellent on broadleaves.
Tillam (1, 2, 4, 5, 7)	Moderate injury in one experiment and none to slight in others.	Fair to good on grasses and poor to fair on broadleaves.
Treflan (2, 3)	Slight reduction in plant fresh weight and moderate reduction in fruiting.	Excellent on grasses and broadleaves at the two test locations for the duration of the experiments.
Vegadex (1, 2, 3, 4, 5)	None to slight injury in all experiments.	Fair to good on grasses and broadleaves; however, poor in control of popolo, tarweed, joee, richardia, and stagger weed.
55 AR oil (1, 2, 4, 5)	None to moderate injury as a directed spray.	Excellent on grasses and broadleaves at the rates used.

GENERAL DISCUSSION AND SUMMARY [2]

Of the chemicals cleared for use, Vegadex (CDEC) at 4 to 6 lb/acre (pounds per acre) was superior when considering crop tolerance and weed control. This herbicide can be applied as a directed preemergence spray or as a granular formulation immediately after transplanting. Furthermore, any injury incurred from spray drift should be minimal as evidenced by over-the-plant sprays. Randox (CDAA) at 4 to 6 lb/acre resulted in excellent weed control at the Waimanalo Experimental Farm; however, poor control of broadleaved weeds at other locations as well as severe crop injury from a broadcast spray and moderate injury from either a directed spray or use of granular formulation suggest limited and cautious use. Dacthal should be

[2] Discussion and summary sections are presented on a per experiment basis in the Appendix.

considered for trial use as a *directed* preemergence spray when it becomes available in Hawaii. The maximum clearance rate of 10.5 lb/acre may be needed to control grasses and a lower rate of 7 lb/acre should give good residual control of several broadleaved weeds.

Tillam is suggested as a preplanting treatment when nutgrass and annual grasses from seed are a problem, but the control of broadleaved weeds may require special consideration.

Aromatic oil is recommended as a postemergence (carefully) directed spray. Since Solan resulted in moderate to severe injury when sprayed over tomato plants the use of this herbicide is limited in the Islands. It may prove feasible as a directed postemergence spray for broadleaved weeds in that little if any crop injury results. However, the aromatic oils are less costly and provide excellent control of grass and broadleaved weeds.

All of the other chemicals tested require additional research to determine their use if any in Hawaii. The excellent weed control and slight to moderate crop injury with Treflan will receive special consideration in future experiments.

APPENDIX

EXPERIMENT NO. 1

(Permanent file copy WC-4)
Poamoho Experimental Farm Field mid-E

Tomato variety:	Anahu (University of Hawaii).
Soil:	Wahiawa silty clay loam.
Experimental design:	Randomized complete block, 4 replications, plot size 5 ft. x 45 ft. (8 plants).
Experimental procedure:	Field preparation Feb. 8, 1962; Field transplanting Feb. 13; Treatment applications–Tillam Feb. 12, Solan and 55 AR oil March 29 (grasses 1 inch in height, broadleaves 1 to 2 inches), all other chemicals March 9 (immediately after cultivation).
Climatic conditions:	*Rainfall:* February 13–.28 inch, 14–.11, 16–1.37, 8–.40, 19–.17, 23–.36, 26–.37, 28–.30, March 3–.13, 5–.14, 8–2.50, 12–1.02, 13–.12, 14–6.60, 17–.18, 26–.50, 28–.25, April 9–.50, 10–.27, 17–.18, 20–.12. *Irrigation:* Furrow irrigated on February 13 and 21, March 23, April 2, 9, and 17.
Weed species:	Most prevalent: *grasses*–sandbur, wiregrass; *broadleaves*–spanish needle, pigweed. Trace amounts: *grasses*–lovegrass; *broadleaves*–swinecress, amaranth spp.
Results:	See Tables 1-1 (Tomato tolerance) and 1-2 (Weed control).

Discussion and Summary:

Tomato tolerance–Tillam, 55 AR oil, and Vegadex (directed spray) resulted in slight to no crop injury. Chloro. I.P.C. and Randox (over-all spray) severely injured the tomato plants. Neburon slowed fruiting; however, the plants had fair foliar growth. Solan caused severe leaf burn and some defoliation. The Vegadex and Randox granular formulations produced no less and occasionally more injury than the *directed* liquid formulations.

Table 1-1. Tomato plant tolerance to the herbicides, Poamoho Experimental Farm, Experiment No. 1

Treatment (pounds per acre)	Plant Injury Rating[1] March 29, 1962 Tillam 5½ weeks after treatment; April 4, 1962 Solan and 55 AR 6 days; March 29, 1962 Others 3 weeks	April 23, 1962 (10 weeks after transplanting) Total fresh weight (pounds) of 4 plants	No. of fruits from 4 plants (diameter 1" and greater)
1. Check	1.5	17.7	34.8
2. Tillam 4 lb. preplant	1.8	17.5	23.0
3. Tillam 6 lb. preplant	2.3	14.5	22.0
4. Vegadex 4 lb. directed	1.8	18.9	27.0
5. Vegadex 6 lb. directed	2.3	18.8	29.0
6. Vegadex 6 lb. over plants	2.8**	15.1	14.0*
7. Vegadex 4 lb. granular	2.0	16.1	21.5
8. Vegadex 6 lb. granular	2.5*	15.4	15.3 *
9. Randox 4 lb. directed	2.5*	14.3	13.5*
10. Randox 6 lb. directed	2.5*	16.5	22.5
11. Randox 6 lb. over plants	4.0**	6.6**	2.8**
12. Randox 4 lb. granular	2.3	15.9	17.5
13. Randox 6 lb. granular	2.5*	16.1	14.0*
14. Neburon 3 lb. directed	3.3**	12.5	9.0**
15. Neburon 4 lb. directed	3.0**	11.8*	6.0**
16. C.I.P.C. 4 lb. granular	3.5**	8.3**	17.3
17. C.I.P.C. 6 lb. granular	3.5**	3.4**	10.3*
18. 55 AR oil 40 gal. directed[2]	2.0	19.8	36.5
19. Solan 4 lb. (p.s.i. 30, gal. 40) over plants	3.8**	11.9*	21.8
20. Solan 4 lb. (p.s.i. 30, gal. 80) over plants	4.0**	7.1**	10.8*
21. Solan 4 lb. (p.s.i. 60, gal. 80) over plants	3.5**	11.1*	18.0
L.S.D., 5% (1%)	.88 (1.17)	5.38 (7.15)	18.8 (25.0)

[1] Rating scale: 1—no injury, 2—slight, 3—moderate, 4—severe, 5—dead.

[2] p.s.i.—pounds per square inch operating pressure.
gal. —total gallons of spray solution used per acre.

* Significantly different from the check at the 5% level (** 1% level).

Table 1-2. Weed control ratings recorded for the various treatments, Poamoho Experimental Farm, Experiment No. 1

Treatment (pounds per acre)	April 4, 1962 [1,2]		April 19, 1962	
	Older grasses	Emerging grasses	Grasses	Broadleaves
1. Check	2.3	2.0	2.0	2.3
2. Tillam 4 lb. preplant	4.8	4.8	4.3	3.8
3. Tillam 6 lb. preplant	4.8	4.8	4.5	4.3
4. Vegadex 4 lb. directed	3.5	3.0	3.8	4.5
5. Vegadex 6 lb. directed	4.0	3.0	3.5	4.0
6. Vegadex 6 lb. overplants	4.3	3.8	3.8	4.5
7. Vegadex 4 lb. granular	3.0	2.3	2.8	2.8
8. Vegadex 6 lb. granular	3.0	2.3	2.8	2.5
9. Randox 4 lb. directed	3.3	3.3	2.3	2.0
10. Randox 6 lb. directed	3.8	4.0	3.0	2.8
11. Randox 6 lb. over plants	3.5	3.0	2.8	3.0
12. Randox 4 lb. granular	3.0	2.3	1.5	1.3
13. Randox 6 lb. granular	4.0	2.5	3.0	3.0
14. Neburon 3 lb. directed	3.8	4.0	4.0	4.8
15. Neburon 4 lb. directed	4.5	4.5	4.3	5.0
16. C.I.P.C. 4 lb. granular	4.5	5.0	4.0	4.3
17. C.I.P.C. 6 lb. granular	5.0	5.0	5.0	4.3
18. 55 AR oil 40 gal. directed	5.0	5.0	4.3	5.0
19. Solan 4 lb. (p.s.i. 30, gal. 40) over plants	4.3	4.0	3.8	5.0
20. Solan 4 lb. (p.s.i. 30, gal. 80) over plants	4.0	4.0	4.0	5.0
21. Solan 4 lb. (p.s.i. 60, gal. 80) over plants	4.0	4.0	4.0	5.0
L.S.D., 5% (1%)	0.9 (1.2)	1.0 (1.3)	1.0 (1.3)	1.0 (1.3)

[1] *Treatments*

	Weeks after treatment	
	April 4	April 19
Tillam	6½	8½
Solan and 55 AR	1	3
Others	4	6

[2] All weed ratings were recorded only on the shoulders; the 6-inch rain disturbed the soil in the furrows.

Rating scale: 1—no control, 2—slight, 3—fair, 4—good, 5—complete control.

Weed control—Tillam, Vegadex, Neburon, 55 AR oil, and C.I.P.C. resulted in good to excellent weed control. Solan up to 3 weeks (experiment terminated) controlled the broadleaves in addition to good control of grasses with only a few escapes. At 4 weeks Randox was comparable to Vegadex, but at 6 weeks Vegadex was superior. The granular formulations of Vegadex and Randox were in several instances inferior to the liquid formulations.

EXPERIMENT NO. 2

(Permanent file copy WC-14)
Poamoho Experimental Farm Field P-2

Tomato hybrid:	N-5 (University of Hawaii).
Soil:	Wahiawa silty clay loam.
Experimental design:	Randomized complete block, 4 replications, plot size 5 ft. x 35 ft. (6 plants per plot).
Experimental procedure:	Field preparation July 17, 1962; Field transplanting July 20; Treatment applications—Tillam sprayed on July 19 and immediately tillivated into the soil surface; Diquat, 55 AR oil, and Solan applied on August 6 (grasses 2 inches in height, broadleaves 1 inch), all other initial treatment applications made on July 23 (some weeds breaking the soil surface in the furrows); final 55 AR oil sprays, treatments 10 and 15, directed on August 22.
Climatic conditions:	*Rainfall (.1 inch and greater)*: July 12—.17 inch; August 1—.19, 10—.10, 26—.10, September 6—.10, 7—.11.
	Irrigation: Furrow irrigated on July 23 shortly before the treatment applications, additional supplemental irrigation applied as needed.
Weed species:	Most prevalent: *grasses*—wiregrass, crabgrass spp.; *broadleaves*—richardia, staggerweed, pigweed (purslane), crotolaria spp.
	Trace amounts: jungle ricegrass.
Results:	See Tables 2-1 (Tomato tolerance) and 2-2 (Weed control).

Table 2-1. Tomato plant tolerance to the herbicides, Poamoho Experimental Farm, Experiment No. 2

Treatment (pounds per acre)	August 22	September 7	
	Injury Rating[1]	Total fresh weight (pounds) of 4 plants	No. of fruits from 4 plants (diameter 1 inch and greater)
1. Check, uncultivated	1.0	13.2	18.3
2. Check, cultivated	1.0	17.8	21.5
3. Tillam 4 lb. preplant	1.8	7.8**	9.0*
4. TRT. No. 3 + Vegadex 4 lb. directed	2.0*	12.9	14.0
5. TRT. No. 3 + Dacthal 6 lb. directed	2.0*	14.6	13.5
6. Diquat 1 lb. directed	2.3**	9.2**	7.9*
7. Vegadex 6 lb. directed	1.3	13.6	14.0
8. Vegadex 6 lb. over plants	1.3	16.3	20.8
9. Vegadex 6 lb. granular	1.3	15.6	19.5
10. TRT. No. 9 and 2nd application oil 40 gal. directed	1.0	14.9	15.8
11. Dacthal 6 lb. directed	1.5	13.6	18.5
12. Dacthal 9 lb. directed	2.8**	8.1**	10.8
13. Dacthal 9 lb. over plants	3.8**	3.6**	3.9**
14. Randox 6 lb. granular	1.3	10.8	9.3*
15. TRT. No. 14 and 2nd application oil 40 gal. directed	1.0	13.3	11.8
16. Neburon 3 lb. directed	2.0*	11.0*	11.3
17. Amiben 4 lb. directed	1.0	16.3	20.0
18. Amiben 4 lb. granular	1.0	15.1	15.3
19. Treflan 6 lb. directed	1.0	16.4	13.8
20. Dymid 6 lb. directed	1.3	15.5	18.8
21. Prometryne 2 lb. directed	5.0**	1.4**	0.5**
22. Casoron 4 lb. directed	1.0	13.9	13.5
23. 55 AR 40 gal. directed	2.0*	12.4	13.3
24. Solan 4 lb. directed	1.0	14.3	14.0
25. Solan 4 lb. over plants	2.5**	7.6**	7.3*
L.S.D. 5% (1%)	0.9 (1.2)	5.5 (7.4)	10.9 (14.4)

[1] Rating scale: 1—no injury, 2—slight, 3—moderate, 4—severe, 5—dead.

* Significantly different from the cultivated check at the 5% level (** 1% level).

Table 2-2. Weed control response to the herbicides, Poamoho Experimental Farm, Experiment No. 2 [1]

Treatment (pounds per acre)	August 22 Weed Rating [2]		August 24 No. of weeds per square foot [3]		
	Grasses	Broadleaves	Richardia	Staggerweed	Pigweed (Purslane)
1. Check, uncultivated	1.0	1.0	1.8	5.4	2.1
2. Check, cultivated	3.3	3.3	0.9	4.5	2.0
3. Tillam 4 lb. preplant	3.0	3.0	1.5	3.7	0.6**
4. TRT. No. 3 + Vegadex 4 lb. directed	3.3	3.0	1.3	2.3**	0.8**
5. TRT. No. 3 + Dacthal 6 lb. directed	4.0	4.0	0.3**	0.3**	0.0**
6. Diquat 1 lb. directed	3.3	3.8	0.3**	3.3**	0.3**
7. Vegadex 6 lb. directed	3.0	2.5	2.8	4.0	1.7
8. Vegadex 6 lb. over plants	3.3	2.5	1.9	4.8	1.0*
9. Vegadex 6 lb. granular	3.0	3.0	1.3	5.3	1.0*
10. TRT. No. 9 and 2nd application oil 40 gal. directed	2.8	2.8	0.0**	0.0**	0.0**
11. Dacthal 6 lb. directed	3.0	3.8	0.1**	0.1**	0.0**
12. Dacthal 9 lb. directed	3.3	4.0	0.3**	0.2**	0.0**
13. Dacthal 9 lb. over plants	3.0	4.0	0.2**	0.1**	0.0**
14. Randox 6 lb. granular	3.8	2.3	1.1	7.1	1.9
15. TRT. No. 14 and 2nd application oil 40 gal. directed	3.8	2.5	0.0**	0.0**	0.0**
16. Neburon 3 lb. directed	3.0	3.5	1.0	1.3**	0.1**
17. Amiben 4 lb. directed	2.3	3.5	0.3**	2.5**	0.4**
18. Amiben 4 lb. granular	2.5	3.0	1.9	0.7**	0.5**
19. Treflan 6 lb. directed	5.0	4.0	0.0**	0.2**	0.0**
20. Dymid 6 lb. directed	3.3	2.5	1.8	3.1*	1.8
21. Prometryne 2 lb. directed	4.0	4.3	0.0**	0.3**	0.0**
22. Casoron 4 lb. directed	2.3	3.8	0.8*	0.6**	1.0*
23. 55 AR 40 gal. directed	4.3	4.0	0.4**	0.2**	0.0**
24. Solan 4 lb. directed	2.3	4.3	0.8*	0.1**	0.0**
25. Solan 4 lb. over plants	3.0	4.3	1.1	0.4**	0.0**
L.S.D. 5% (1%)	0.8 (1.0)	0.8 (1.0)	1.0 (1.3)	1.9 (2.6)	1.1 (1.4)

[1] Data recorded only in furrows since shoulders had very limited weed growth because of dry weather.

[2] Weed rating: 1—no control, 2—slight, 3—fair, 4—good, 5—complete.

[3] An average of three readings per plot.

* Significantly different from the uncultivated check at the 5% level (** 1% level).

Discussion and Summary:

Tomato tolerance—Dacthal (over plants) and Prometryne caused severe injury. Tillam, Diquat, Dacthal (high rate directed), Neburon, Randox (granular), and Solan (over plants) resulted in sufficient crop injury to merit further consideration. All other treatments showed no significant reductions in total plant fresh weight, and in number of fruits as well.

Weed control—Treflan, Prometryne, 55 AR oil, and Tillam plus Dacthal exhibited the best control of both grasses and broadleaves. Randox gave good control of grass, but poor control of the broadleaved-weed species. The control of broadleaved weeds with Solan, Casoron, Dacthal, and Diquat was commercially acceptable; however, the control of grass was poor to fair.

EXPERIMENT NO. 3

(Permanent file copy WC-24)
Waimanalo Experimental Farm Field C-2

Tomato hybrid:	N-5 (University of Hawaii).
Soil:	Waimanalo silty clay.
Experimental design:	Randomized complete block, 3 replications, plot size 5 ft. x 40 ft. (7 plants).
Experimental procedure:	Field preparation Oct. 25, 1962; Field transplanting Oct. 26; Treatment applications—Solan No. 7 (grasses 1 to 2 inches, broadleaves 2 inches), all other treatments Oct. 27.
Climatic conditions:	*Rainfall (over .10 inch)*: December 5—.10 inch, 10—.30, 13—1.63, 14—1.66, 17—2.00, 20—.23, 24—1.20, 25—.15.
	Irrigation: Furrow irrigated on Oct. 26, 31, Nov. 9, 14, 19, 21, 26, 30, Dec. 3, and 10.
Weed species:	Most prevalent: *grass*—wiregrass; *broadleaves*—spiny amaranth, pigweed (purslane).
	Trace amounts: *broadleaves*—popolo, garden spurge, swinecress.
Results:	See Tables 3-1 (Tomato tolerance) and 3-2 (Weed control).

Discussion and Summary:

Tomato tolerance—Moderate to severe injury was observed 14 days after Solan was sprayed over the tomato plants as compared to no injury when used as a directed spray. The plant weight and fruiting results were nonsignificant; however, cognizance should be made of the tendency for reduced weights and number of fruits with Randox, Dacthal (over plants), Treflan, and Solan (over plants).

Weed control—All formulations used in this experiment resulted in good to excellent control of the broadleaved weeds. Randox and Treflan provided excellent control of wiregrass as compared to poor to fair control with Solan. Although Vegadex and Dacthal exhibited incomplete wiregrass control the results were commercially acceptable.

Table 3-1. Tomato plant tolerance to the herbicides, Waimanalo Experimental Farm, Experiment No. 3

Treatment (pounds per acre)	November 21, 1961	January 4, 1962	
	Injury Rating [1]	Total fresh weight (pounds) of 4 plants	No. of fruits from 4 plants (diameter 1 inch and greater)
1. Check, uncultivated	1.0	9.3	27.7
2. Check, cultivated	1.0	13.0	29.4
3. Vegadex 6 lb. directed spray	1.3	11.8	23.5
4. Vegadex 6 lb. over plants	1.3	11.0	26.6
5. Vegadex 6 lb. granular	1.3	11.2	20.8
6. Randox 6 lb. directed	1.3	10.4	18.1
7. Randox 6 lb. granular	1.7	10.9	16.4
8. Dacthal 6 lb. directed	1.3	12.4	21.6
9. Dacthal 6 lb. over plants	1.7	9.6	19.2
10. Treflan 6 lb. directed	1.3	9.8	16.4
11. Solan 4 lb. directed	1.0	14.9	31.2
12. Solan 4 lb. over plants	3.7**	7.4	18.4
L.S.D. 5% (1%)	0.9 (1.2)	n.s.	n.s.

[1] Rating scale: 1—no injury, 2—slight, 3—moderate, 4—severe, 5—dead.

** Significantly different from the cultivated check at the 1% level.

Table 3-2. Weed control ratings recorded for the various species, December 4, Waimanalo Experimental Farm, Experiment No. 3[1]

Treatment (pounds per acre)	Wire-grass	Spiny Amaranth	Pigweed (Purslane)	Popolo	Garden Spurge	Swine-cress
1. Check, uncultivated	1.0	1.0	1.0	3.7	3.7	3.7
2. Check, cultivated	2.7	2.3	3.0	2.7	3.0	3.7
3. Vegadex 6 lb. directed spray	3.7	5.0	5.0	4.0	5.0	4.3
4. Vegadex 6 lb. over plants	4.3	5.0	5.0	4.3	4.3	4.7
5. Vegadex 6 lb. granular	4.3	4.7	5.0	4.0	5.0	5.0
6. Randox 6 lb. directed	5.0	5.0	5.0	5.0	5.0	5.0
7. Randox 6 lb. granular	5.0	5.0	4.7	5.0	4.7	5.0
8. Dacthal 6 lb. directed	3.7	5.0	5.0	4.7	4.7	4.3
9. Dacthal 6 lb. over plants	3.7	4.3	5.0	4.7	4.7	4.0
10. Treflan 6 lb. directed	5.0	5.0	5.0	5.0	5.0	5.0
11. Solan 4 lb. directed	3.3	5.0	5.0	5.0	5.0	5.0
12. Solan 4 lb. over plants	2.7	4.7	5.0	5.0	4.7	5.0
L.S.D. 5%	0.9	0.7	0.9	1.3	n.s.	n.s.
L.S.D. 1%	1.2	1.0	1.2	1.7		

[1] Rating scale: 1—no control, 2—slight, 3—fair, 4—good, 5—complete control.

EXPERIMENT NO. 4

(Permanent file copy WC-9)
Waimanalo Experimental Farm Field R-1

Tomato variety: Anahu.

Soil: Waimanalo silty clay.

Experimental design: Randomized complete block, 4 replications, plot size 5 ft. x 40 ft. (8 plants).

Experimental procedure: Field preparation April 3, 1962; Field transplanting April 6; Treatment applications—Tillam April 4 (tillivated immediately), all treatments other than Tillam, Solan, and 55 AR oil April 9, Solan and 55 AR oil April 20, Treatments 11, 12, and 13 (See Table 4-2) 2nd application May 18.

Climatic conditions:	*Rainfall (.1 inch and greater)*: April 10–.36, 15–.72, 16–.12, 18–.18, 19–.13, 21–.10, 26–.96, May 3–.11, 4–.17, 5–.41, 6–1.03, 8–.21, 15–.37, 15 to 24–0.
	Irrigation: Furrow irrigated on April 6, 13, 23, 30, May 4 and 21.
Weed species:	Most prevalent: *grasses*–wiregrass, sandbur, *broadleaves*–spiny amaranth.
	Trace amounts: *broadleaves*–sow thistle, popolo, smooth rattle pod, garden spurge.
Results:	See Tables 4-1 (Tomato tolerance) and 4-2 (Weed control).

Discussion and Summary:

Tomato tolerance–Solan and granular C.I.P.C. resulted in very severe crop injury. The injury incurred with Amiben, Tillam plus Vegadex, granular Randox, and Prometryne needs further attention. All other formulations resulted in slight or no injury.

Weed control–Amiben, Dacthal, Randox, 55 AR oil, and Tillam plus Vegadex resulted in excellent weed control for all species in this experiment. The excellent control with Randox on the Waimanalo silty clay is of special interest since this chemical has performed poorly in experiments on other island soils. Solan, C.I.P.C., and Neburon exhibited poor grass control. Vegadex and Tillam resulted in fair to good weed control, the combination of both chemicals was excellent. Note that Tillam was only fair on grasses in the furrow. The furrow irrigation used on the island of Oahu presents a special problem with Tillam in that weed growth is often present in the furrow bottoms. Further attention is needed to study cultural practices which might overcome this problem.

Table 4-1. Tomato plant tolerance to the herbicides, Waimanalo Experimental Farm, Experiment No. 4

Treatment (pounds per acre)	May 1	May 24[2]	
	Injury Rating[1]	Fresh weight per plant, in pounds	No. of fruits per plant (diameter 1 inch and greater)
1. Check, uncultivated	1.0	2.20	5.8
2. Check, cultivated	1.3	2.69	5.5
3. Tillam 4 lb. preplant	2.3**	1.74	3.4
4. Tillam 6 lb. preplant	2.3**	2.19	3.6
5. Vegadex 4 lb. directed	1.0	3.13	7.2
6. Vegadex 6 lb. directed	1.5	3.03	7.9
7. Vegadex 6 lb. over plants	1.8	2.92	5.4
8. Vegadex 4 lb. granular	1.8	2.70	7.0
9. Vegadex 6 lb. granular	1.8	2.35	4.5
10. Tillam 4 lb. preplant + Vegadex 4 lb. directed	2.8**	2.39	2.6
11. Vegadex 4 lb. directed (Original intent 2 or more applications.)	1.3	2.63	7.3
12. Vegadex 4 lb. granular (Original intent 2 or more applications.)	1.5	2.25	5.1
13. Vegadex 6 lb. granular (Original intent 2 or more applications.)	2.8**	2.49	5.0
14. Randox 6 lb. directed	2.0*	2.69	4.3
15. Randox 6 lb. granular	2.3**	1.81	2.5
16. Neburon 3 lb. directed	1.0	2.39	5.6
17. C.I.P.C. 4 lb. granular	4.5**	.94	1.6
18. 55 AR oil 40 gal. directed	2.5**	2.72	2.7
19. Solan 4 lb. pressure 30 p.s.i. over plants	5.0**	.22	0.5
20. Solan 4 lb. pressure 60 p.s.i. over plants	5.0**	.36	0.5
21. Amiben 4 lb. directed	2.0*	1.80	2.6
22. Amiben 4 lb. granular	3.0**	1.24	1.3
23. Casoron 3 lb. directed	1.8	2.52	5.7
24. Prometryne 1 lb. directed	2.3**	2.40	3.4
25. Dacthal 9.0 lb. directed	1.5	3.58	8.8
26. Dacthal 10.5 lb. directed	1.8	3.25	6.7
L.S.D. 5% (1%)	0.6 (0.8)		

[1] Rating scale: 1—no injury, 2—slight, 3—moderate, 4—severe, 5—dead.

[2] Treat the data accumulated on May 24 *with caution,* occasionally an average of only 2 healthy plants per replicate. A severe disorder, hollow stem, caused several plants to wilt (unknown origin).

* Significantly different from the cultivated check at the 5% level (** 1% level).

Table 4-2. Weed control ratings for the treatments, Waimanalo Experimental Farm, Experiment No. 4

Treatment (pounds per acre)	May 1, 1962 [1, 2]				May 7, 1962	
	Furrow		Shoulder		Shoulder	
	G	B	G	B	G	B
1. Check, uncultivated	1.0	1.3	1.5	1.5	1.0	1.0
2. Check, cultivated	3.8	4.5	4.0	4.3	3.3	3.5
3. Tillam 4 lb. preplant	3.0	4.0	5.0	3.8	4.5	2.3
4. Tillam 6 lb. preplant	3.8	4.3	5.0	4.3	4.5	3.5
5. Vegadex 4 lb. directed	4.3	5.0	3.5	4.5	3.3	4.3
6. Vegadex 6 lb. directed	3.8	5.0	3.5	4.5	3.3	3.8
7. Vegadex 6 lb. over plants	4.3	5.0	4.0	4.5	3.8	4.3
8. Vegadex 4 lb. granular	4.0	5.0	3.3	4.3	3.0	3.5
9. Vegadex 6 lb. granular	4.8	5.0	4.0	4.5	3.3	4.0
10. Tillam 4 lb. preplant + Vegadex 4 lb. directed	4.8	5.0	4.8	5.0	5.0	5.0
11. Vegadex 4 lb. directed } Original intent	4.5	5.0	4.0	4.3	3.5	3.8
12. Vegadex 4 lb. granular } 2 or more	4.3	5.0	3.5	4.0	3.0	3.8
13. Vegadex 6 lb. granular } applications.	4.5	5.0	3.8	4.5	3.3	3.5
14. Randox 6 lb. directed	5.0	4.8	5.0	5.0	4.8	4.5
15. Randox 6 lb. granular	5.0	5.0	4.5	4.5	4.8	4.3
16. Neburon 3 lb. directed	3.8	5.0	3.0	4.8	2.8	3.8
17. C.I.P.C. 4 lb. granular	3.3	4.0	2.5	2.0	2.0	1.5
18. 55 AR oil 40 gal. directed	4.5	5.0	4.3	4.8	3.8	5.0
19. Solan 4 lb. pressure 30 p.s.i. over plants	2.8	5.0	3.3	5.0	2.5	4.5
20. Solan 4 lb. pressure 60 p.s.i. over plants	2.5	5.0	3.0	5.0	2.3	5.0
21. Amiben 4 lb. directed	5.0	5.0	5.0	5.0	5.0	5.0
22. Amiben 4 lb. granular	5.0	5.0	4.8	5.0	5.0	5.0
23. Casoron 3 lb. directed	3.3	4.5	3.3	3.8	3.0	3.3
24. Prometryne 1 lb. directed	4.0	5.0	3.5	4.5	3.3	4.5
25. Dacthal 9.0 lb. directed	4.5	5.0	4.3	5.0	4.3	5.0
26. Dacthal 10.5 lb. directed	4.8	5.0	4.8	4.8	4.5	4.5
L.S.D. 5%	0.8	0.4	0.8	0.6	0.8	0.9
L.S.D. 1%	1.1	0.6	1.1	0.8	1.1	1.2

[1] May 1, 1962. Treatments 18 to 20 1½ weeks after treatment, all others 3 weeks.

[2] Rating scale: 1—no control, 2—slight, 3—fair, 4—good, 5—complete control.

EXPERIMENT NO. 5

(Permanent file copy WC-13A)
Kauai Branch Station Field D, Wailua

Tomato hybrid:	N-5 (University of Hawaii).
Soil:	Halii gravelly silty clay.
Experimental design:	Randomized complete block, 3 replications, plot size 4 ft. x 20 ft. (5 plants).
Experimental procedure:	Field preparation May 2, 1962; Field transplanting May 3; Treatment applications—Tillam sprayed and immediately tillivated in before transplanting on May 3, Solan and 55 AR oil directed sprays on May 17, all other treatments applied May 4. Forty gallons of solutions were sprayed per acre at 20 pounds pressure.
Climatic conditions:	*Rainfall (over .10 inch):* May 3—.20 inch, 4—.26, 7—1.17, 8—.36, 9—.12, 10—.36, 13—.13, 15—.43, 16—1.30, 17—.35, 18—.22, 19—.17, 20—.14, 21—.24, 22—.10, 23—.72, 27—.12.
Weed species:	Most prevalent: *broadleaves*—popolo, red pualele, orange pualele, tarweed, graceful spurge, sow thistle, and joee.
Results:	Table 5-1. Weed control and tomato tolerance to herbicides, Kauai Branch Station Experiment No. 5.

Discussion and Summary:

Tomato tolerance—The only noticeable injury was a moderate burning of the older leaves contacted by the Solan and oil sprays. Yield differences were not significant between treatments.

Weed control—Solan and 55 AR oil provided commercially acceptable weed control. This information is especially valuable in that the broadleaved-weed species in this experiment are somewhat resistant to most commercially available tomato herbicides. Tillam and Randox did not control the weeds. Vegadex resulted in an over-all rating of fair to good weed control; however, the control was poor with popolo, tarweed, and joee.

Table 5-1. Weed control and tomato tolerance to herbicides, Kauai Branch Station Experiment No. 5

Treatment (pounds per acre)	Weed Control	Tomato Response	
	Weed Rating [1] June 1 (4 weeks)	Crop Rating June 1	Total Yield (pounds per plot)
1. Control	1.3	1.0	42.9
2. Tillam 4 lb. preplant	2.7**	1.7**	47.0
3. Vegadex 6 lb. directed	3.3**	1.0	53.4
4. Vegadex 6 lb. granular	3.7**	1.3*	46.4
5. Randox 6 lb. granular	2.3*	1.0	50.6
6. Dacthal 7 lb. directed	3.3**	1.0	47.2
7. Solan 10 lb. directed [2]	4.0**	1.3*	48.3
8. 55 AR 200 gal. directed	5.0**	1.3*	50.9
L.S.D. 5% (1%)	1.0 (1.3)	0.3 (0.5)	n.s.

[1] Weed rating: 1—no control, 2—slight, 3—fair, 4—good, 5—complete.
Crop rating: 1—no injury, 2—slight, 3—moderate, 4—severe, 5—dead.

[2] Original intent Solan 4 lb. and 55 AR oil 20 gallons per acre.

** Significantly different from the control at the 5% level (** 1% level).

EXPERIMENT NO. 6

(Permanent file copy WC-6A)
Tom Sakugawa Farm—Omaopio, Maui

Tomato variety:	Homestead.
Experimental design:	Randomized complete block, 2 replications.
Experimental procedure:	Solan was applied at 3 and 4 pounds per acre as a post-emergence spray on February 16, 1962. Eighty gallons of solution were sprayed per acre at 20 pounds pressure. The tomato plants had two main stems with the second cluster of flowers open. Weed growth was approximately 1 to 2 inches in height.
Climatic conditions:	Severe rainstorm 4 hours after spray application with cloudy and rainy conditions for 3 days thereafter.
Results:	Solan did not kill the weeds; however, growth was checked for 2 weeks. Three weeks after treatment the weeds were 9 inches high and growing fast. Visual inspection revealed no phytotoxicities to the tomato plants.

Discussion and Summary:

The rainfall immediately after treatment may have been responsible for the poor weed control. Also, it is unsafe to accept the no-injury result to the tomato plants because of the possible dilution effect of the rainfall.

EXPERIMENT NO. 7

(Permanent file copy WC-6B)
Yoshihiro Nakamura Farm–Kula, Maui

Soil: Waimea fine sandy loam.

Experimental design: Randomized complete block, 2 replications, plot size 5 ft. x 20 ft.

Experimental procedure: Tillam was sprayed on the soil surface at the rate of 4 and 6 pounds per acre on February 16, 1962, and immediately tillivated. Forty gallons of solution were sprayed per acre at 20 pounds pressure. Tomatoes were transplanted on February 17.

Climatic conditions: Heavy rainstorm approximately 6 hours after treatment.

Weed species: *Grasses*–wiregrass, lovegrass; *broadleaves*–cheese weed, lambsquarters, amaranth spp., swinecress, apple of Peru.

Results: Table 7-1. Tomato and weed response to herbicides.

Table 7-1. Tomato and weed response to herbicides

Date	Weeks after treatment	Treatments	
		Check	Tillam 4 and 6 pounds per acre
March 18	4	All weeds growing rapidly	No grasses showing, most broadleaves above ground but definitely stunted
March 26	5	Rapid growth of all weeds	Essentially no grasses, broadleaves present and very stunted. Tomato plants slightly smaller than in control area
April 8	7	Very rank growth	Weeds nearly as high as tomatoes, experimental area hoed

Discussion and Summary:

Tillam controlled the grasses; however, the limited control of the broadleaves is of concern. No tomato yield data were recorded, but there were indications of some stunting.

UNIVERSITY OF HAWAII
COLLEGE OF TROPICAL AGRICULTURE
HAWAII AGRICULTURAL EXPERIMENT STATION
HONOLULU, HAWAII
